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ART. XXII.—*Mineral Resources of Southern India. No. 4.*
Gold Tracts. By LIEUT. NEWBOLD, F.R.S. &c., *Madras Army.*

(Read June 4th, 1842.)

THOUGH it is my intention to confine this series of papers, as much as possible, to notices of mineral localities within the limits of Southern India, I have deemed right, in this paper, with reference to the importance of the subject, to travel beyond these boundaries, and cast a cursory glance at the vast geographical extent over which auriferous deposits are scattered throughout our Indian possessions; at the same time particularizing, in a more detailed form, such localities within the specified limits as have been undescribed by former observers: namely, those of the Southern Mahratta country, of which I had given a cursory notice, prior to quitting Madras, in the *Journal of the Branch Society* for January, 1840. Of the gold tracts on the Malay peninsula detailed accounts will be found in my work on our settlements in that part of the globe; therefore little will be said of them here.

It is certain that gold occurs in large deposits in our Oriental possessions from the Himalayas to Singapore, or from 30° N. lat. to the equator; and it is equally true that these deposits have been, comparatively speaking, totally unexplored, so far as regards the application of *practical* European skill, capital, and experience. In many instances, worked in the rudest way by the natives, they have yielded remunerating returns; but the greater portion have been deserted, or only occasionally worked, from their supposed poverty. The unsatisfactory mode in which we have usually tested the value of such deposits has been to employ natives under the superintendence of a civil or military servant of the government, who, however capable in other respects, has had invariably little or no practical knowledge in mining. The speculations of private individuals have failed from similar causes, and want of capital. The auriferous sands of the Ural, externally as poor as those of India, and until lately entirely neglected, now yield a large annual sum to the Russian government, under the management of experienced miners and the shelter of Imperial protection. Until similar stimuli are applied to the latent mineral resources of India, we may in vain hope for their development. I should certainly suggest the examination of

the most promising localities,—of Mysore, Malabar, and the Southern Mahratta country,—by experienced miners or engineers from the gold tracts of the Tyrol, Ural, or Brazil.

Gold Tract in the Southern Mahratta Country.

In the Southern Mahratta country, between the 15th and 16th degrees of North lat. and 75th and 76th of East long., there is an auriferous tract embracing a range of hills termed the Kupput-gode, in which the existence of gold has been known to the former native chiefs of that part of India for ages back. Christie, in his valuable paper on the Geology of the Southern Mahratta country, does not mention the occurrence of this metal, nor does he allude to it in his slight notice of the Kupput-gode range. We may therefore reasonably infer that he either was ignorant or uncertain of its existence; and that the merit of its first having been brought to the notice of the English government may be fairly attributed to the researches of a highly-intelligent native inhabitant of Darwar, named Trimulrow. This Brahman youth, whose acquirements and thirst after useful knowledge do credit to the tuition of the Rev. Dr. Wilson of Bombay, after whose system of education he was brought up, informs me that, having heard that there were many medicinal plants, flints, diamonds, gold sand, coal, and iron ore to be found among the hills I have just mentioned, determined to explore them, and accordingly did so in the month of March, 1839; and gives us an interesting account of his trip, in the *Oriental Christian Spectator* for July, 1839.

He did not succeed in his attempt to visit the *situs* of these minerals, with the exception of that of the iron ore, which he describes as having met with in his ascent of the hills. Four men, however, whom he sent subsequently to the hills, brought specimens of some of the minerals mentioned; but were not successful in their search after diamonds, which it is probable, from the nature of the formation, do not exist in the vicinity. The sandstone formation of Noulgoond, a little to the N. W., would be a more likely locality for the occurrence of this gem. The "coal" was pronounced, by the editor of the journal in which Trimulrow's notes were published, an "iron ore, probably containing some plumbago." From the dark, shining appearance of this mineral, the natives had given it the name of Iddali Kallu, charcoal-stone; hence it was mistaken for coal. The existence of gold and flint was proved, beyond the possibility of doubt, by specimens of each; which, with a few others of the surrounding formation, were for-

warded by Trimulrow to Dr. Wilson for deposit in the museum of the Bombay branch of the Royal Asiatic Society.

During a recent tour through the Southern Mahratta country, I was informed at Darwar, by Mr. Pelly, assistant to the collector, and also by Trimulrow, that the locality whence the specimens of gold dust had been procured, was the bed of a rivulet near the village of Doni, two or three miles south of Dummul. I subsequently found, on visiting the hills, that gold also existed in the bed of the rivulet near Hurti, a little to the south of Gudduck, in the Soltoor Nala; and it is also said to be found near Chick Mulgoond, in the Kor taluk.

Auriferous formation.—The formation of the Kupput-gode range is principally gneiss, hornblende, and mica schists, passing into clay, flinty and chloritic slates;—in their upper portions ferruginous and quartzose; and, in some localities, capped by thin beds of laterite. They contain thin beds and veins of a beautifully white subcrystalline limestone, resembling statuary marble, which near its contact with the hornblende schist acquires a greenish tinge. Gneiss occurs principally on the flank of the hills,—both felspathic and quartzose, and often much weathered. In some situations the mica abounds so much that hand-specimens of the rock would be termed mica slate: in others, this mineral is entirely wanting, and it then consists of quartz and felspar, possessing a distinctly laminar arrangement. Velvet black crystals of schorl, and green actinolite are found generally associated with the quartz veins. The quartz itself often assumes a roseate hue. The dip is nearly vertical at Dummul; near Gudduck I found it 38° towards the N. E.; direction of strata S. 20° E. On an examination of some of the higher peaks at an elevation of about 1000 feet above the plain, the dip is irregular and in some conical elevations quâquâversal.

The range derives its name from a small but sacred temple to Kupput Iswara, situated in a romantic defile near the summit of one of the highest peaks: it commences a little to the south of Gudduck, and runs with a curvilinear direction E. by S. diverging, as it approaches the western bank of the Tumbuddra, into three distinct chains, the principal of which appears to be continued on the opposite bank into the Ceded Districts. The two others terminate at unequal distances before reaching the river. The extreme height of the range is about 1500 feet from the level of the plain. Its elevation and singular divergement is ascribable to the upheaving forces of an immense dyke of basaltic greenstone, which is seen occasionally protruding at the base and flanks of the range, and in the low

spaces extending between the divergements just alluded to. The developments of this plutonic rock are accompanied and marked by large deposits of a travertine-like kankar, with which the rocks in the vicinity are penetrated, and in some places overlaid. Considerable tendency to silicification is also remarked: the schists are profusely varied with quartz, white, roseate, a diaphanous blue, and black. Thin veins of basanite also penetrate the rock. I crossed the range near its western extremity, south of Gudduck, and passed along its northern flank to the village of Cuddumpur, above which the range bifurcates. Near this the northern spur is crossed to Doni, a village situated between the two ranges considerably east from the point of divergement, and on the right bank of a rivulet which has its rise near the bifurcation, and runs easterly down the valley of Doni to the Dummul tanks, which it feeds. Its waters flow over a bed of sand and gravel resting on masses of granite and gneiss. Immediately opposite this village the gold dust is found mingled with the sand and pebbles of the bed of the stream; but, according to the natives on the spot, in quantities hardly sufficient to repay the washer.

The process of washing is carried on only after the rains by which the gold is brought down from its matrix in the hills, a short distance to the west. Little or no work is done during the dry season, but the place is crowded by the Jalgars, (native gold-washers,) immediately after any heavy fall of rain, when the profits treble the disbursements. The rivulets of Hurti and Soltoor, the latter about four koss from Doni, are more productive, though I did not see many persons at work at Hurti. The process of washing the gold is simple, and does not differ essentially from the mode adopted in Mysore, Malabar, or from that I have seen practised by Chinese gold-washers at Mount Ophir. After the larger pebbles and lighter quartzose sand are washed away, the gold dust is easily discernible in a black, shining, heavy sand that remains, most of the particles of which are powerfully attracted by the magnet—the granular magnetic iron ore of mineralogists. Menachanite is sometimes found mixed with it, and also, though rare, a few whitish metallic spangles, probably of platinum; comminuted fragments of malachite also occur: one, a little larger than the rest, contained an irregularly-shaped fragment of native copper, which, from its dark rough surface, I thought at first was hæmatite, but in endeavouring to break it with a smart blow of the hammer, I flattened it. A few small scattered grains of a grayish-white metal are seen, but rare. One of them had a slightly-yellow tinge, resembling the auriferous silver of Norway.

The largest of these metallic substances—a flattened, water-worn button about half the size of a pea, having a purplish-black *enduit*—on being submitted to re-agents, proved to consist almost entirely of silver. I should have been induced to suppose, from the scarcity of this metal in the rocks of India, that the presence of this fragment here had been adventitious, had I not discovered gray silver ore in a fragment of quartz shortly afterwards¹.

Sir Whitelaw Ainslie informs us (*Mat. Med.*, vol. i., p. 562-3) that silver occurs in trifling quantities in Upper Hindustan. In Lower India, he was informed that Mr. W. Mainwaring found it in its native state in the Madura district, associated with zinc, sulphur, iron, fluoric acid, silica, and water, forming a yellow blende, perhaps somewhat similar to that found at Ratiborziz in Bohemia. Captain Arthur, he states, was the first who discovered this metal in small quantities in Mysore, both in its native state, in thin plates, adhering to some specimens of gold crystallized in minute cubes, and mineralised with sulphur, iron, and earthy matter, forming a kind of brittle sulphuretted silver ore. Dr. Heyne (*Tracts*, pp. 315, 316) tells us that, in the Nellore and Calastry districts, on the Coromandel coast, a galena of lead, rich in silver, was found some years ago, and that the same ore has also been discovered eight miles north of Cuddapah. The mine had been, according to Ainslie, formerly worked by order of Tippoo, but abandoned because not sufficiently productive. It would appear, he adds, that the ore had been lately analysed in Bengal, and found to contain eleven per cent. of silver. But the specimens I brought recently from this locality, and now lodged in the Society's Museum, do not appear, from Mr. E. Solly's analysis, to contain silver. The pebbles and gravel composing the bed of the rivulet are derived from the surrounding formation—gneiss, and its associated schists, kankar, hæmatite, iron ore, quartz, and a few garnets.

The Jalgars have from time immemorial been acquainted with the art of collecting gold by amalgamation; it is formed into a ball with a small portion of mercury, washed and cleared from the sand, and placed on an ignited bit of charcoal or cowdung, which is blown into a glow by the operator's breath impelled through a hollow bamboo. The mercury is volatilized, and the gold remains.

They are ignorant of the art of refining it by cupellation or the liquid process, but contrive to bring it to a high state of purity by means of heating it—carefully avoiding fusion—with a mixture of

¹ For Lieut. Braddock's analysis of the ores I brought from this locality, *vide* *Madras Journal*, January, 1840, pp. 49, 50, 51.

cowdung, ashes, or old brick dust, and muriate of soda, in equal parts. The metal is beaten into thin plates, and piled up in alternate layers with this flux, to which a little borax is sometimes added, and the process repeated until the touch-stone evinces the requisite stage of purity. By this operation, it may be presumed that the muriatic acid evolved combines with and rids the gold of the silver or copper with which it is usually alloyed. The action of the ashes or brick-dust is chiefly mechanical, keeping the plates asunder, and permitting volatilization. The Egyptians, we are told by Agatharcides, also employed heat not carried to fusion, with muriate of soda, in purifying gold.

Many particles of gold are lost in the process of washing, and the whole of the mercury by volatilization; the former of which might be saved by the use of a magnet, and the latter by employing retorts for its sublimation.

The produce of the three rivulets of Hurti, Soltoor, and Doni is estimated at about 200 ounces per annum after an average monsoon. The gold occurs generally in flattened, irregularly-shaded spangles, and chiefly in the line of drainage or lowest part of the bed. The gold-washers do not appear to have attempted to trace the gold up to its matrix, which cannot be far distant. A Mussulman, who accompanied me to the spot, informed me that he obtained four rupees' worth of gold in two days. The hire of the three Jalgars, &c., whom he employed amounted to half that sum, leaving two rupees clear profit. The ancient lords of the soil, the Dessayes of Dummul, formerly levied a toll from the gold-washers, which ceased with the authority of the last chief, who was hanged, by order of the Duke of Wellington, over the gate of his own fortress, for firing on a flag of truce at the siege of that place.

Iron-stone and hæmatitic iron ore are smelted at Doni, and as the furnace was at work, I stepped in to witness the operation, which I found not to differ from the usual process adopted in Southern India, and which I have before described. The furnace was, as usual, of clay, worked by two bellows which kept up a constant blast. About one and a half maunds, or forty-eight pounds, are usually smelted during the day. The iron, after being roughly beaten into koralis, plough-shares, and other agricultural implements, sells at about two rupees the maund. The ore is twice smelted.

From what has been said above, the geognostic position of the gold in this auriferous tract is, doubtless, in veins and scattered grains in the primary schists, and is associated with quartz, iron

ore, menachanite, copper ore, and probably platinum and silver. Gold has an immensely-extended distribution in India, and particularly in that part of it termed the Peninsula. It is found in the sands of the Indus, the Irawadi, the Brahmaputra, and the Ningti; in those of the sacred Gundak, whose source is supposed to be among the loftiest peaks of the Himalayas; in those of the Infra Himalayan chain, of the hills of Kamaon, the Bhont Mahals, and Nahan, particularly those of the Raniganga and its tributaries, the Koh and the Phika; and also the Goomti and Dhela. The gold mines of Pakerguri, at the junction of the Donhiri stream with that of the Brahmaputra, produce, it is said, about 375 ounces annually. The sands of the Dikrung, too, which falls into the Brahmaputra, are celebrated for the remarkable fineness and purity of their gold. The beds of the rivers of Cuttack and Gondwana, the Mahanadi, with its innumerable branches, the Suvarna Reka, or Stream of the Golden Sands, the Lanji, the Godavery, and some parts of the bed of the Kistna, and the streams about Vizagapatam, are auriferous.

Proceeding still further south, we come to an auriferous tract, described by Lieutenant Warren in the Asiatic Annual Register, lying at the base of the Bateria hills in Mysore, near Baitmungalum, particularly in the immediate vicinity of Marcupum, Shapur, Warigaum, Dassera Cottapilly, and the Manigutta, Wullur, Yeldur, and Randur-Papanilly hills. It also occurs in this neighbourhood in the bed and banks of the Palaur, a river that takes its rise among the granite and gneiss clusters around Nandidrug, and in those of the Panaur near Karguri. To the west of Bangalore, in the bed of a rivulet that washes the base of a short chain of hills immediately to the S.W. of the village of Belladara, I discovered, in 1837, a few spangles of gold. Ainslie, in his *Materia Medica* (vol. i. p. 514), states that Captain Warren discovered a gold mine in Mysore in 1800, betwixt Annikal and Punganore: possibly those near the Bateria hills just alluded to.

Descending the peninsula towards Cape Comorin, gold is found abundantly in the sands of the rivers and rivulets of Malabar and Coimbatore, and indeed in those of the whole of the country at the base of the Nilgherri and Khundah mountains, comprising an auriferous tract of about 1500 square miles. The most noted localities are those of Malliyalum, near the frontier of Mysore, noticed by Dr. Clark (*Madras Journal* for January, 1839, p. 120), where the golden region is rented from Government by a native chief, and Nilambur, the mines of which have been described by the late Dr.

Ward; according to whom, the produce was about one grain of gold from sixty-five pounds of earth, and the annual gross amount 750 ounces. The mines in the Wynad district then worked were those of Cherankode Devala, Nelyalam, Ponery, and Pulyode. In Calicut, the gold is found in the beds of the Srupumji, the Baypur, Polwye, and Tirumpaddy; in Kurmenad, the Punaur and Malapuram streams; in Nedinganad, the Pandalur and Aliparamb; in Shernad, the Kudalaondy and Parpanangady; in Ernad, the Kapil and Aripnad; and also the Tirumaly and Kundanad hills.

I have not been able to trace the existence of gold farther south than Madura, where, according to Ainslie, (*Mat. Med.*, vol. i., p. 514.) "it was discovered by the late Mr. Mainwaring, mineralised by means of zinc, constituting a blende, perhaps resembling somewhat the Schemnitz blende of Hungary; and we know, from Cronstedt, that the zinc ores of Schemnitz contain silver which is rich in gold." Ainslie does not mention the nature of the formation in which this mineralised gold occurs; but we know that granite and the primary schists occupy the greater portion of this part of India.

The geognostic position of gold, in all the localities I have enumerated, appears to be in the primary schists, viz., gneiss, mica-slate, clay-slate, and hornblende schist, particularly near the line of their contact with granite or basaltic dykes, where we generally find the tendency to siliceous and metallic development unusually great. The gold in these situations is almost invariably discovered either in thin veins or disseminated in grains in the veins and beds of quartz, associated with iron ore, and sometimes platinum, and alloyed with small proportions of silver and copper, or in the tracts of alluvial soil, beds of clay and sands, the washings of primary rocks; all of which, in the auriferous tracts, will be found to abound in siliceous and ferruginous matter. The sands generally contain a large quantity of a black magnetic iron-sand, which, in the process of washing, from its greater gravity, sinks with the particles of gold to the bottom of the vessel or hollowed plank upon which it is submitted to the action of water. When the gold occurs in alluvial beds of clay, soil, or quartz gravel, the iron is found in a higher state of oxidation, imparting various shades of yellow, red, and brown, to the decomposing quartz and felspar constituting the matrix of the gold.

With reference to the theory of the agency of heat, evolved from basaltic dykes, in stimulating the mysterious influence, electric or otherwise, causing the development of metals and metallic ores in rocks, it is an interesting fact, that the richest gold mines in the

eastern hemisphere all occur in primary formations, situated generally along the edges of the great volcanic belt of the Indian Archipelago. The matrix of gold on the Malayan Peninsula, and in the vast islands of Borneo and Sumatra, is usually quartz veins, and beds in primary formations; and in alluvial soils, clay beds, and sands, the result of their disintegration. The mines are, for the most part, in these alluvial beds; but where the metal can be traced up to the matrix, the laborious process of breaking up the quartz beds, and separating the gold by a lengthy operation of pounding and sifting, is found in the end far more profitable than the washing alluvial clays and sands. The gold mines of Taon and Gominchi, on the Malayan Peninsula, are in a bed of solid white quartz, of extreme hardness. I possessed two specimens of this rock, containing thin veins of gold and disseminated particles, one of which is unfortunately lost; the other is deposited in the Museum of the Asiatic Society of Bengal. The gold at the foot of Mount Ophir is obtained from washing the alluvial soil and sand in the beds of streams. The rich mines of Sumbas on the island of Borneo are excavated in a bed of ferruginous quartz; and the mineral, we are told, is invariably associated with this gold of Sumatra. In South America, North America, and Hungary, it forms auriferous veins in the mica slate, which Humboldt informs us is extremely rich in metallic ores.

It would be an interesting, and might prove a not unprofitable research, to attempt to trace the gold found in the alluvial auriferous tracts of Southern India to its matrix; and should this idea be ever put into execution, it would be well to bear in mind that the general direction of the quartz veins and beds in the primary formations of the peninsula is about E.S.E.; nor should those localities, where they or the embedding schists come in contact with basaltic dykes or granite, be neglected, as affording doubtless the most favourable conditions for metallic development. In tracing streams, the sands of which contain particles of gold, the sand, &c. should be attentively examined as the source is approached, and the vicinity of the spot where the gold no longer appears in the bed most carefully explored.
